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(54) ALUMINUM ALLOY SACRIFICIAL ANODE MATERIAL FOR HEAT EXCHANGER AND HIGH CORROSION-RESISTANT ALUMINUM ALLOY COMPOSITE MATERIAL FOR HEAT EXCHANGER

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an anode material having an excellent sacrificial effect in both of acidic and alkaline corrosive environments by preparing the material containing Zn and Ni of a specified compsn. and the balance Al and inevitable impurities.

SOLUTION: This material contains 3.1 to 15.0 wt.% Zn and 0.2 to 3.0 wt.% Ni, and is preferably obtd. by cladding an aluminum alloy sacrificial anode material to one surface of an aluminum alloy core material, and then cladding an Al-Si alloy brazing material to the other surface of the core material. Or, an Al alloy comprising 0.05 to 1.2 wt.% Si; 0.05 to 0.8 wt.% Fe; 0.003 to 1.2 wt.% Cu; 0.05 to 2.0 wt.% Mn and the balance Al and inevitable impurities is used as the core material, and the Al alloy sacrificial anode material is clad to the one surface of the core material. Further, the alloy may contain one or more kinds of 0.03 to 0.5 wt.% Mg; 0.03 to 0.3 wt.% Cr; 0.03 to 0.3 wt.% Zr; 0.03 to 0.3 wt.% Ti and 0.05 to 2.0 wt.% Ni. By using the material for the pipes of a heat exchanger, high reliability is obtd.

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CLAIMS

[Claim(s)]

[Claim 1] Aluminium alloy sacrificial anode material for heat exchangers which contains nickel 0.2 - 3.0wt% Zn 3.1 - 15.0wt%, and consists of the remainder aluminum and an unescapable impurity.

[Claim 2] High corrosion resistance aluminium alloy composite for heat exchangers characterized by having carried out the clad of the aluminium alloy sacrificial anode material according to claim 1 to one side of an aluminium alloy core material, and carrying out the clad of the aluminum-Si system alloy wax material to other one side of this core material.

[Claim 3] High corrosion resistance aluminium alloy composite for heat exchangers characterized by having contained Mn 0.05 - 2.0wt%, having made into the core material the aluminium alloy which consists of the remainder aluminum and an unescapable impurity, and carrying out the clad of the aluminium alloy sacrificial anode material according to claim 1 to one side of this core material Cu 0.003 - 1.2wt% Fe 0.05 - 0.8wt% Si 0.05 - 1.2wt%.

[Claim 4] Si 0.05 - 1.2wt%, Fe 0.05 - 0.8wt%, Cu 0.003 - 1.2wt%, Mn 0.05 - 2.0wt% is contained. Further Mg 0.03 - 0.5wt%, Cr 0.03 - 0.3wt%, Zr 0.03 - 0.3wt%, Ti 0.03 - 0.3wt%, High corrosion resistance aluminium alloy composite for heat exchangers characterized by having contained one nickel 0.05 - 2.0wt% sort or two sorts or more, having made into the core material the aluminium alloy which consists of the remainder aluminum and an unescapable impurity, and carrying out the clad of the aluminium alloy sacrificial anode material according to claim 1 to one side of this core material.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to aluminium alloy sacrificial anode material and aluminium alloy composite applicable to both the acid and alkaline suitable refrigerants for tube tubing of the heat exchanger for automobiles manufactured by soldering.

[0002]

[Description of the Prior Art] For example, the radiator of the heat exchanger for automobiles A fin (2) is arranged between tube tubing (1) which is the things of the structure shown in (**) and lets a refrigerant pass. the drawing 1 (**) -- After attaching a header plate (3) in the both ends of tube tubing (1), respectively and soldering an assembly and this assembly for a core (4), through packing (5), a resin tank (6) and (7) are attached and it is manufactured by the header plate (3). And it is the structure which cools this refrigerant by letting a refrigerant pass in tube tubing (1) of such a radiator. In addition, the side face of a core (4) is usually reinforced by the side plate (not shown).

[0003] here -- said fin -- JIS-3003 alloy (aluminum-0.15wt%Cu-1.1wt%Mn) -- Zn -- about 1.5wt% -- sheet metal with a thickness of about 0.1mm added is used. moreover, in aluminium alloy composite (brazing sheet) with a thickness of 0.2-0.4mm which made JIS-3003 alloy the core material, looked wax material like [the one side] on the other hand, and carried out the clad of the JIS-7072 alloy (aluminum-1wt%Zn) to it as sacrificial anode material for pitting prevention, said sacrificial anode material is carried out inside (refrigerant side), and what carried out **** processing is used for tubed at said tube tubing. Furthermore, the aluminium alloy composite of the same quality of the material as tube tubing with a thickness of 1.0-1.3mm is used for the header plate.

[0004] Although the neutrality - acidity refrigerant has been conventionally used for the refrigerant of a heat exchanger, an alkaline refrigerant is also used in recent years in many cases, and the ingredient which bears the corrosive environment of acid and alkaline both is demanded of tube tubing. For this reason, advanced tube tubing (JP,9-176768,A etc.) using the sacrificial anode material which added various alloy elements into JIS-7072 alloy is proposed.

[0005]

[Problem(s) to be Solved by the Invention] However, when this invention person etc. investigated about said advanced tube tubing, it became clear that corrosion resistance with said tube tubing sufficient in the bottom of alkaline corrosive environment was not acquired. As this cause, two points, under the alkaline corrosive environment to which **pH exceeds 10, the natural electrode potential of a core material (JIS-3003 alloy) shifts to a ** side, and potential relation with sacrificial anode material (aluminum-1 - 3%Zn alloy) is reversed [that an aluminum-hydroxide coat generates on a sacrificial anode material front face under ** alkalinity corrosive environment, and the sacrifice effectiveness of sacrificial anode material is checked and], were mentioned.

[0006]

[Means for Solving the Problem] Based on these, this invention person etc. advanced research wholeheartedly and succeeded in development of the aluminium alloy composite which is excellent in the corrosion resistance which used said sacrificial anode material for the aluminium alloy sacrificial anode material list which shows the sacrifice effectiveness excellent in the bottom of both acid and alkaline corrosive environment.

[0007] That is, this invention is aluminium alloy sacrificial anode material for heat exchangers which contains nickel0.2 - 3.0wt% and consists of the remainder aluminum and an unescapable impurity Zn3.1 - 15.0wt%.

[0008] Moreover, high corrosion resistance aluminium alloy composite for heat exchangers of this invention is characterized by having carried out the clad of the above-mentioned sacrificial anode material to one side of an aluminium alloy core material, and carrying out the clad of the aluminum-Si system alloy wax material to other one

side of this core material.

[0009] Moreover, other high corrosion resistance aluminium alloy composites for heat exchangers of this invention are characterized by having contained Mn0.05 - 2.0wt%, having made into the core material the aluminium alloy which consists of the remainder aluminum and an unescapable impurity, and carrying out the clad of the above-mentioned aluminium alloy sacrificial anode material to one side of this core material Cu0.003 - 1.2wt%, Fe0.05 - 0.8wt%, Si0.05 - 1.2wt%.

[0010] Furthermore other high corrosion resistance aluminium alloy composites for heat exchangers of this invention Si0.05 - 1.2wt%, Fe0.05 - 0.8wt%, Cu0.003 - 1.2wt%, Mn0.05 - 2.0wt% is contained. Further Mg0.03 - 0.5wt%, Cr0.03 - 0.3wt%, Zr0.03 - 0.3wt%, Ti0.03 - 0.3wt%, It is characterized by having contained one nickel0.05 - 2.0wt% sort or two sorts or more, having made into the core material the aluminium alloy which consists of the remainder aluminum and an unescapable impurity, and carrying out the clad of the above-mentioned aluminium alloy sacrificial anode material to one side of this core material.

[0011]

[Embodiment of the Invention] The aluminium alloy sacrificial anode material of this invention makes aluminum contain Zn so much, and it is made for natural electrode potential to become ** from a core material also under the alkaline corrosive environment of pH10 **, and specified quantity content of the nickel is carried out, this is distributed as a detailed intermetallic compound, and generation of the aluminum-hydroxide coat under alkaline corrosive environment is suppressed, with the sacrificial anode effectiveness is enough demonstrated also under an alkaline environment.

[0012] In less than [3.1wt%], the reason for having specified the content of Zn to 3.1 - 15.0wt% in this invention is for rolling workability to fall here, when the effectiveness is not fully acquired but exceeds 15.0wt%. in addition -- since the natural electrode potential of a core material shifts to a ** side sharply under alkaline corrosive environment -- sacrificial anode material -- Zn -- more than 6.1wt% -- it is desirable to make it contain and to make potential of sacrificial anode material into ** enough.

[0013] Moreover, in less than [0.2wt%], the reason for having specified the content of nickel to 0.2 - 3.0wt% is for rolling workability to fall to the self-corrosion resistance list of sacrificial anode material, when the generation depressor effect of said hydroxylation coat is not fully acquired but exceeds 3.0wt%. Especially the content of desirable nickel is 0.2 - 1.2wt%.

[0014] Si of an unescapable impurity element -- less than [0.5wt%] -- if it can do, less than [0.1wt%] is desirable. impurity elements other than Si -- each 0.05 -- it is satisfactory even if it is contained, if it is less than [wt%].

[0015] Next, the aluminium alloy composite of this invention carries out the clad of said aluminium alloy sacrificial anode material to one side of an aluminium alloy core material. The alloy element of the aluminium alloy core material specified by this invention below is explained.

[0016] After soldering, Si dissolves in a matrix and raises the reinforcement of a core material. In less than [0.05wt%], the reason for having specified the content of Si to 0.05 - 1.2wt% is for Si to deposit alone and for the self-corrosion resistance of a core material to fall, when the effectiveness of raising reinforcement is not fully acquired but exceeds 1.2wt%. 0.1 - 0.8wt% of especially the content of Si is desirable.

[0017] Fe is distributed in a matrix as a big and rough intermetallic compound, makes crystal grain of a core material detailed, and prevents generating of the crack when fabricating in tube tubing. In less than [0.05wt%], the reason for having specified the content of Fe to 0.05 - 0.8wt% is for the self-corrosion resistance of a core material to fall, when the effectiveness is not acquired enough but exceeds 0.8wt%. 0.05 - 0.3wt% of especially the content of Fe is desirable.

[0018] Cu affects the improvement in on the strength of a core material, and corrosion resistance. In less than [0.003wt%], the reason for having specified the content of Cu to 0.003 - 1.2wt% is for the melting point to fall and for a core material to fuse locally with heating at the time of soldering, when the effectiveness of raising reinforcement is not acquired enough but exceeds 1.2wt%, although excelled in corrosion resistance. Especially this is because Cu re-deposits on a core material front face under alkaline corrosive environment, this re-sludge serves as a powerful cathode and the self-corrosion resistance of a core material is reduced. Therefore, when not requiring reinforcement so much, Cu can raise the self-corrosion resistance of a core material by making the content into less than [0.01wt%]. Moreover, although the self-corrosion resistance of a core material falls by making the content of Cu more than 0.01wt% when reinforcement is required, the reinforcement of a core material can be raised. Even when thinking core material reinforcement as important, if said local melting is taken into consideration, the upper limit of Cu will become 1.2%.

[0019] Mn forms a detailed intermetallic compound, is distributed in a matrix, and it raises the reinforcement of a core

material, without reducing corrosion resistance. In less than [0.05wt%], the reason for having specified the content of Mn to 0.05 - 2.0wt% is for rolling workability to fall, when the effectiveness of raising reinforcement is not fully acquired but exceeds 2.0wt%. 0.5 - 1.5wt% of especially the content of Mn is desirable.

[0020] Each Cr, Zr, Ti, and nickel of a selection element form a detailed intermetallic compound, and raise the reinforcement of a core material. The reason for having specified the content of Cr, Zr, and Ti to ***** 0.03 - 0.3wt% is for the occurrence frequency of the flume gap to which the effectiveness of all raising reinforcement is not acquired enough, but exceeds 0.3wt% of a casting crack to increase in less than [0.03wt%]. Especially the desirable content of these elements is 0.08 - 0.2wt%, respectively. Although the content of nickel was specified to 0.05 - 2.0wt%, the reason for a convention is the same as cases, such as said Cr. Especially the desirable content of nickel is 0.08 - 1.0wt%.

[0021] With Si, Mg carries out the aging deposit of the Mg-Si system compound, and raises reinforcement. In less than [0.03wt%], the reason for having specified the content of Mg to 0.03 - 0.5wt% is to be spread in wax material, and for Mg to react with flux, to shine, and for a sex to fall, in case the effectiveness of raising reinforcement is not acquired enough but will exceed [attaching and] 0.5wt%.

[0022] B for making an ingot organization detailed, or other unescapable impurity elements -- each 0.05 -- if it is less than [wt%], even if it contains, it does not interfere.

[0023] What carried out the clad of the aluminium alloy sacrificial anode material of said presentation to one side of an aluminium alloy core material, and carried out the clad of the aluminium alloy wax material to one side of further others is contained in the aluminium alloy composite of this invention. As said wax material, JIS-4343 alloy (aluminum-7.5wt%Si) of an aluminum-Si system, JIS-4045 alloy (aluminum-10wt%Si), JIS-4004 alloy (aluminum-9.7wt%Si-1.5wt%Mg), etc. can be used here.

[0024] The aluminium alloy composite of this invention is applicable to tube tubing and the header plate of a heat exchanger. And said tube tubing can be formed by the approach of soldering the conventional **** processing method and the edge of a barrel which carried out bending processing etc.

[0025]

[Example] This invention is explained from an example below at a detail.

[0026] (Example of this invention) Metal mold casting of the core material alloy of a presentation and the alloy of sacrificial anode material which were specified by this invention shown in Table 1 was carried out, respectively, facing of the ingot for core materials was carried out to 35mm in thickness, and after facing, the ingot for sacrificial anode material was hot-rolled, and was taken as the plate with a thickness of 10mm. Moreover, after facing, the ingot which carried out metal mold casting of the JIS-4343 alloy, and obtained it was hot-rolled, and was used as the plate for wax material with a thickness of 5mm.

[0027] Said plate for sacrificial anode material, the ingot for core materials, and the plate for wax material were hot-rolled at 500 degrees C in piles in this order, it considered as the three-layer clad plate with a thickness of 5mm, and this was cold-rolled in thickness of 0.29mm, after giving intermediate annealing subsequently heated at 340 degrees C for 2 hours, it cold-rolled and aluminium alloy composite (brazing sheet of H14 material) with a thickness of 0.25mm was manufactured. The rate of a clad of wax material of the rate of a clad of sacrificial anode material was 10% 20% here.

[0028] (Example of a comparison) The alloy presentation of a core material and sacrificial anode material was made into the outside of a convention of this invention as shown in Table 1, and also aluminium alloy composite was manufactured by the same approach as the example of this invention.

[0029]

[Table 1]

	No.	芯材組成 (wt%)							鍍層材料組成 (wt%)		
		Si	Fe	Cu	Mn	Cr, Zr, Ti, Mg, Ni	Al	Zn	Ni	Al	
本 発 明 例	1	0.09	0.75	0.004	1.12	Cr 0.15 Ti 0.01	残	3.8	2.45	残	
	2	0.12	0.53	0.007	1.83	Ti 0.10 Zr 0.04	〃	3.5	1.34	〃	
	3	0.24	0.09	0.003	0.31	Ni 1.52	〃	13.4	0.23	〃	
	4	0.52	0.23	0.006	1.10	Mg 0.13 Ti 0.14	〃	12.5	1.02	〃	
	5	0.48	0.34	0.005	0.92	Ni 0.73	〃	7.5	0.54	〃	
	6	1.14	0.10	0.008	1.45	Zr 0.09 Mg 0.05	〃	6.5	1.34	〃	
	7	0.89	0.23	0.007	0.94	Ni 0.32	〃	8.5	0.57	〃	
	8	0.92	0.63	0.19	0.53	Ni 0.56	〃	9.8	0.74	〃	
	9	0.82	0.23	0.28	0.95		〃	5.3	1.01	〃	
	10	0.74	0.31	0.34	1.14	Ti 0.16	〃	8.4	0.45	〃	
	11	0.63	0.24	0.38	1.20		〃	8.1	1.31	〃	
	12	0.32	0.23	0.58	1.12	Mg 0.18	〃	5.9	0.34	〃	
	13	0.51	0.20	0.51	1.18	Ti 0.09	〃	3.5	0.65	〃	
	14	0.58	0.14	0.51	1.31		〃	8.3	0.43	〃	
	15	0.49	0.34	0.49	1.02	Cr 0.12	〃	13.8	1.23	〃	
	16	0.81	0.34	0.54	1.02	Mg 0.15	〃	6.5	0.54	〃	
	17	0.32	0.08	0.81	0.30		〃	7.4	0.48	〃	
	18	0.08	0.54	1.10	0.11		〃	3.9	0.87	〃	
比 較 例	19	0.52	0.23	0.008	1.23	Ni 0.16	〃	2.0	0.73	〃	
	20	0.64	0.31	0.007	0.85		〃	7.4	0.13	〃	
	21	0.34	0.53	0.51	1.32	Mg 0.15	〃	16.9	0.57	〃	
	22	0.54	0.27	0.004	0.94		〃	8.4	3.38	〃	
	23	1.32	0.43	0.003	0.84		〃	7.5	0.51	〃	
	24	0.43	0.39	1.36	1.10		〃	8.3	0.53	〃	
従 来 例	25	0.31	0.42	0.151	1.10		〃	1.0		〃	

[0030] About each obtained aluminium alloy composite (brazing sheet), the tension test and the corrosion resistance test were performed. The corrosion resistance test followed both under an acid environment and an alkaline environment. Investigation with the same said of the conventional material was conducted.

[0031] [Tension test] The tension test was performed, after processing each aluminium alloy composite into the JIS No. 5 test piece for tensile test and heat-treating this for 3 minutes at 600 degrees C (soldering potential equivalent temperature) in nitrogen gas.

[0032] [Corrosion resistance test] **** processing of each aluminium alloy composite was carried out, it considered as tube tubing (die length of 500mm, width of face of 16mm of a cross section, height of 2mm), and an assembly and this heat exchanger were made to carry out predetermined period circulation of the acid or alkaline etching fluid for the heat exchanger of the structure shown in drawing 1 using this tube tubing. Then, it sampled ten tube tubing at a time at random from each heat exchanger, and the pitting depth of a tube material inside was measured by the depth of focus method using an optical microscope. Measured value was rounded off, was expressed per 5 micrometers, and displayed the maximum depth of them.

[0033] Under the present circumstances, what carried out corrugated processing of the sheet metal material with a thickness of 0.1mm it is thin from an aluminum-0.5wt%Si-1.0wt%Mn-2.0wt%Zn alloy was used for the fin. moreover - a header plate and a side plate -- JIS-3003 alloy -- Mg -- 0.15wt(s)% -- aluminium alloy composite with a thickness of 1.2mm which carried out the clad of the wax material of JIS-4343 alloy for the sacrificial anode material of an aluminum-1.5wt%Zn alloy at 10% of rates of a clad at other one side, respectively was used for one side of the added core material.

[0034] And in acid etching fluid, it is Cl. - The water solution (pH3) containing ion 195 ppm, SO₄ 2-ion 60 ppm, Cu²⁺ ion 1 ppm, and Fe³⁺ ion 30 ppm was used. Moreover, in alkaline etching fluid, it is Cl. - The liquid which added NaOH in the water solution containing ion 195 ppm, SO₄ 2-ion 60 ppm, Cu²⁺ ion 1 ppm, and Fe³⁺ ion 30 ppm, and was adjusted to pH11 was used.

[0035] These results are shown in Table 2. In addition, O was appended to that to which tensile strength exceeds 150 MPa in Table 2 at the following [O and 150 MPa]. Moreover, x and the maximum pitting depth appended O to that to which the maximum pitting depth exceeded 100 micrometers at the thing 100 micrometers or less. Moreover, in the case of the corrosion resistance test in alkaline etching fluid, the maximum pitting depth appended O to the thing 70 micrometers or less.

[0036]

[Table 2]

	No.	引 張 強 さ (MPa)	酸性腐食液に 対する孔食深さ (μ m)	アルカリ性腐食 液に対する孔食 深さ (μ m)
本 発 明 例	1	132	○	45
	2	137	○	50
	3	142	○	70
	4	138	○	40
	5	136	○	60
	6	144	○	45
	7	140	○	50
	8	158	◎	45
	9	153	◎	55
	10	167	◎	45
	11	161	◎	60
	12	173	◎	55
	13	187	◎	50
	14	181	◎	50
	15	185	◎	45
	16	191	◎	50
	17	195	◎	50
	18	193	◎	65
比 較 例	19	132	○	85
	20	137	○	45
	21	圧延途中で割れて製造不可		
	22	141	○	貫通
	23	148	○	170
	24	ろう付け時に溶融		
従 来 例	25	113	○	70

[0037] It is an example of this invention so that more clearly than Table 2. The pitting depth showed the outstanding corrosion resistance of 100 micrometers or less under both corrosive environment acid in No.1-18, and alkaline. Especially the amount of Zn of sacrificial anode material is more than 6.1wt%, and the amount of Cu(s) of a core material is below 0.01wt%. Each especially No.3-7 was excellent in the corrosion resistance under alkaline corrosive environment. Moreover, the amount of Cu(s) of a core material is beyond 0.01wt%. Tensile strength is over 150 MPa and No.8-18 were especially excellent.

[0038] On the other hand, corrosion resistance fell in either under acidity or alkaline corrosive environment, or an alloy presentation was not able to manufacture the example of a comparison (No.19-24) and the conventional example (No.25) besides this invention convention as a heat exchanger. Since No.19 had few Zn contents of sacrificial anode material, under alkaline corrosive environment, they could not take the potential difference of sacrificial anode material and a core material, but corrosion resistance was inferior in them. Since No.20 had few nickel contents of sacrificial anode material, under alkaline corrosive environment, the firm coat was formed in the sacrificial anode material front face, and a corrosion prevention operation did not work, but corrosion resistance was inferior in them. Since No.21 had too many Zn contents of sacrificial anode material, they are in the middle of rolling, broke, and were not able to manufacture aluminium alloy composite. Since No.22 had too many nickel contents of sacrificial anode material, the self-corrosion resistance of sacrificial anode material fell to the bottom of acidity and alkalinity both corrosive environment. Since No.23 had too many Si contents of a core material, Si simple substance deposited in the core material, and the self-corrosion resistance of a core material fell to the bottom of acidity and alkalinity both corrosive environment. Since No.24 have too many Cu contents of a core material, the tube has fused them at the time of soldering heating. Moreover, although No.25 were the conventional example, since there were few Zn contents of sacrificial anode material as 1.0wt(s)%, under alkaline corrosive environment, the potential difference of sacrificial anode material and a core material could not be taken, but corrosion resistance was inferior.

[0039]

[Effect of the Invention] As stated above, the aluminium alloy sacrificial anode material of this invention shows the sacrifice effectiveness excellent in the bottom of both acid and alkaline corrosive environment, and the aluminium alloy composite using said sacrificial anode material shows the corrosion resistance excellent in the bottom of both acid and alkaline corrosive environment, uses it for tube tubing of a heat exchanger etc., and high dependability is acquired.

Therefore, remarkable effectiveness is done so on industry.

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CLAIMS

[Claim(s)]

[Claim 1] Aluminium alloy sacrificial anode material for heat exchangers which contains nickel 0.2 - 3.0wt% Zn 3.1 - 15.0wt%, and consists of the remainder aluminum and an unescapable impurity.

[Claim 2] High corrosion resistance aluminium alloy composite for heat exchangers characterized by having carried out the clad of the aluminium alloy sacrificial anode material according to claim 1 to one side of an aluminium alloy core material, and carrying out the clad of the aluminum-Si system alloy wax material to other one side of this core material.

[Claim 3] High corrosion resistance aluminium alloy composite for heat exchangers characterized by having contained Mn 0.05 - 2.0wt%, having made into the core material the aluminium alloy which consists of the remainder aluminum and an unescapable impurity, and carrying out the clad of the aluminium alloy sacrificial anode material according to claim 1 to one side of this core material Cu 0.003 - 1.2wt% Fe 0.05 - 0.8wt% Si 0.05 - 1.2wt%.

[Claim 4] Si 0.05 - 1.2wt%, Fe 0.05 - 0.8wt%, Cu 0.003 - 1.2wt%, Mn 0.05 - 2.0wt% is contained. Further Mg 0.03 - 0.5wt%, Cr 0.03 - 0.3wt%, Zr 0.03 - 0.3wt%, Ti 0.03 - 0.3wt%, High corrosion resistance aluminium alloy composite for heat exchangers characterized by having contained one nickel 0.05 - 2.0wt% sort or two sorts or more, having made into the core material the aluminium alloy which consists of the remainder aluminum and an unescapable impurity, and carrying out the clad of the aluminium alloy sacrificial anode material according to claim 1 to one side of this core material.

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